Empowering Occupational Therapists with a DIY-toolkit for Smart Soft Objects

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ABSTRACT

We present an evaluation of a DIY-toolkit, designed to empower caregivers to create tailor-made, unique assistive solutions for their clients. More specifically, the toolkit aims to enable occupational therapists to turn everyday soft objects into smart devices that can be programmed to recognize certain manipulations. These smart objects can then be used to control applications or to play certain games. Our evaluation reveals that occupational therapists were able to make use of the toolkit without the aid of a technical expert. The therapists hacked everyday objects such as cushions, socks, cuddly toys and repurposed them for therapy. They computationally augmented them and tailored them to clients' needs and desires. From our evaluation, we also derive five guidelines that can inform others when creating DIY-toolkits for assistive technology.

ACM Classification Keywords

H.5.2 Information Interfaces and Presentation

Author Keywords

Tangible interaction, solutions for occupational therapy, DIY toolkit, assistive technologies, organic interfaces

INTRODUCTION

Within the field of physical rehabilitation and assistive technology, there has been a call for empowering individuals with Do-It-Yourself Assistive Technology [10,11,12]. The term DIY refers to a movement of creating, modifying or repairing objects without the need for substantial training or professional assistance [13]. Within the field of assistive technologies (AT), the argument is made that when clients, caregivers, family and friends, are able to create or adapt assistive technologies themselves, these technological solutions are better tailored to the complex needs of the individual with disabilities. Some advocates of DIY-AT even argue that 'user self-production' can lead to disruptive innovation in rehabilitation engineering [4].

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Current high abandon rates of assistive technologies, ranging from 8 to 75% [17,18,22], indeed suggest that assistive devices and services often fail to meet the needs of end-users. Lack of user involvement has repeatedly been listed as the main factor associated with assistive technology discontinuance [19]. Other factors that contribute to abandonment of AT are suboptimal performance, high barriers to procuring the device, and finally inadequate flexibility to adapt the technology to changes in ability, needs and lifestyles [17]. Caregivers have the most intimate knowledge of the specific needs of their clients. If they would be given the means and knowledge to participate in the design of AT, perhaps these limitations of poor performance, restricted delivery or improper fit can be avoided. By *"making the making accessible",* perhaps these high abandonment rates may be mitigated [11].

In this paper we provide an account how we evaluated a DIY-AT toolkit, designed to empower caregivers, and more specifically occupational therapists, to create tailor-made, unique assistive solutions for their clients.

Occupational therapy as a creative practice

Occupational therapists (OTs) aim to remediate impairments and functional limitations [26], in order to maximize a person's ability to perform activities of daily living such as dressing, cooking, bathing, toileting, writing, and other common household and work-related tasks. While definitely not exclusive, occupational therapy often focuses on activities involving the upper body, and frequently includes activities to improve manual dexterity and bimanual skills [24]. As clients differ with respect to their disability, the context they live in and the daily activities that are significant to them, therapeutic procedures need constant adaptation and innovation [23]. Therefore, OTs spend significant effort in finding the right tools and adapting equipment. Another core element of the work of an OT is to increase a client's motivation for adherence to the therapy [24]. Although most clients look forward to spending time with the therapist [1], the actual motivation for executing repetitive and boring exercises is often lacking. Hence, OTs often search for interactive tools and games, as a means to add immediate feedback and fun to the therapy [7,15].

Occupational therapy is known to be a creative profession, both as a practice and in its use of fun, challenged to show creativity in applying functional activities for the benefit of clients [8,23,25]. However, while OTs are without doubt professionals in designing and tailoring therapeutic procedures, they do not have an engineering background. Therefore, with respect to creating assistive *technologies* they should be considered as non-professionals [13]. Hence, OTs in particular could benefit from DIY technology that enables them to tailor solutions to the abilities of the individual client, and that allows to add immediate feedback and fun to the therapy.

The Skweezee system

Within the domain of Tangible Interaction (TI) it is common practice to augment daily objects with computational power by using appropriate sensors, electronics, microprocessors and actuators. This opens up opportunities for OTs, since their clients typically have difficulties manipulating objects. Embedding sensors in physical objects allows for monitoring and for providing feedback which may increase the clients' motivation to practice. In our project we started from the work of Vanderloock et al. who presented the Skweezee system [27]. Skweezees are soft objects that are filled with conductive wool (see figures 1 and 3). Inside the wool electrodes are dispersed. By compressing the wool the resistance between a pair of electrodes drops, which allows to measure the deformation of the object, and to recognize preprogrammed deformations through machine learning algorithms. Consequently, this technology has the potential to respond to actions like pushing, grasping, pinching and squeezing the object.

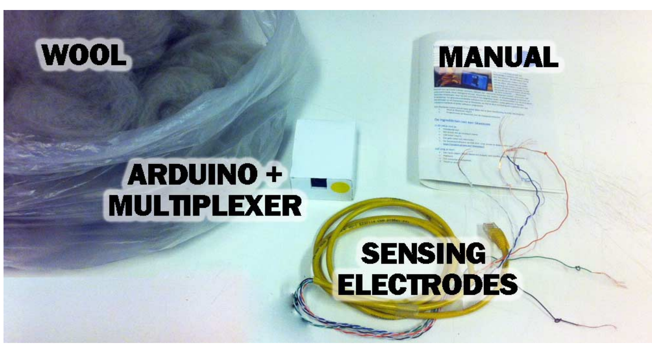

Figure 1. An overview of the hardware materials of the Skweezee, as used in the DIY-toolkit.

In this research study, we investigated how and whether this Skweezee system can be extended in order to enrich the set of tools that OTs use in their practice. First, we provide an overview of related work in the field of tangible interaction, assistive technology and DIY practices. Next we discuss the components of the DIY-AT toolkit. Finally, we present and discuss an evaluation of the DIY-AT toolkit by OTs. We analyze their creations and interviews, and describe themes that emerged from the observations. We hope these results may inform other researchers to create similar DIY-tools for assistive technology.

RELATED WORK

In order to empower OTs to create tailor-made solutions, we need to combine elements from the domain of *tangible interaction* with typical practices of the *DIY movement* and the needs of *OTs*.

First, we look at existing applications that combine **tangible interaction with a DIY approach**. A notable example is "Makey Makey" [3], a platform for improvising tangible user interfaces using physical and digital objects. Textile interfaces were presented in [16], where diverse materials and fabrics are used to handcraft fabric electronics. "Midas" [21] is a toolkit to support the design, fabrication, and programming of flexible capacitive touch sensors for interactive objects. This is also where the Skweezee system situates itself, a flexible and open system for designing and developing squeeze-based interactions. Skweezees aspire to make interactive devices of everyday soft objects and to provide the DIY community with a means for rich gestural squeeze interactions. However, in [27] no real end users were involved and no concrete applications were proposed. Rather, the technology is described, and the robustness of the system is tested via experiments. While participants could define their own squeeze gestures, they were not capable of creating their own Skweezee. Designing this toolkit, the ambition is to move beyond the DIY community and exploit tangible interfaces in the domain of assistive technologies.

Secondly, numerous applications exist that combine **tangible interaction with occupational therapy**. "NoiseBear" [9] for example, is a malleable multiparametric tangible interface that can be used by children with limited mobility or learning disabilities. "PhysiCube" takes advantage of tangible interactions and games to provide motivating physical training for the upper limbs [28]. In [14], a table-top game supporting the treatment of children with Cerebral Palsy is presented. In [2], the authors present a sensing and tangible interaction environment for post-stroke and upper limb rehabilitation. However, in the aforementioned examples, the DIY aspect is lacking. Solutions are often created by technical developers, and although these solutions offer the possibility for adaptation and customizations [7], they do not provide the means to end-users to fabricate their own solutions.

Lastly, we explore services and technologies that combine the **DIY mentality with assistive technology**. Several books have this as a topic, e.g. Willkomm, sometimes referred to as the McGyver of AT, has written a book on how to create "*assistive technology solutions in minutes*" [29]. Other similar specialists websites [30,31] and online communities [32] have arisen, where people can find and share ideas and designs for making (therapeutic) tools themselves. However, generally, these are low-tech solutions. Hurst and Tobias (in [12:16]) remark that *"manufacturing techniques are limited by what can be made without electricity and using found objects. […] These limitations may impact the adoption rate and potential for long-term use solutions."*

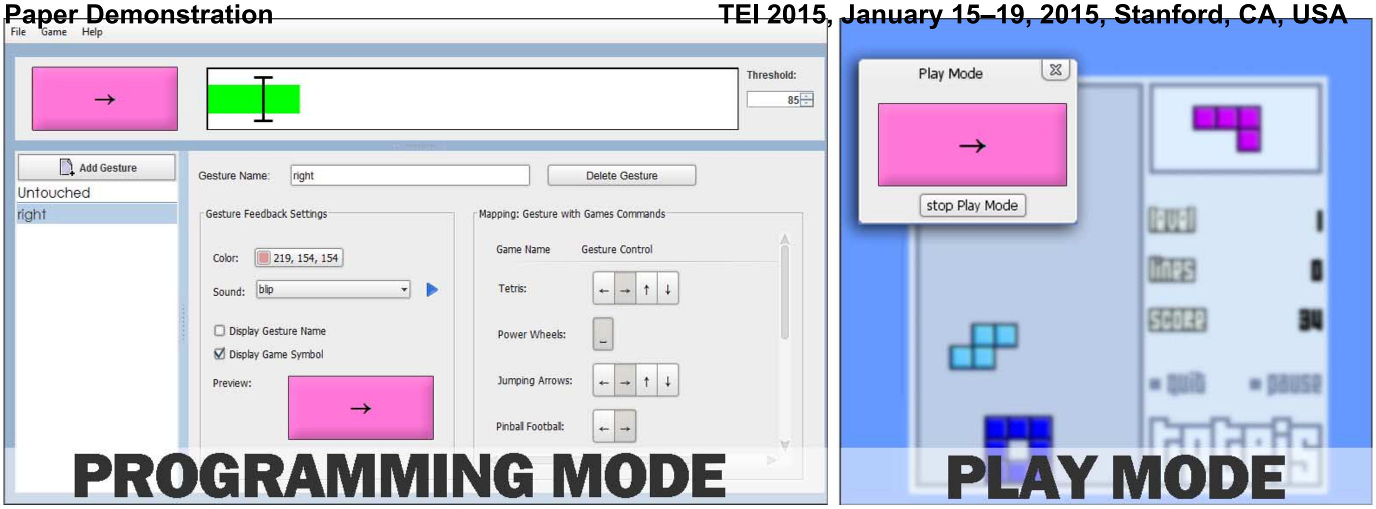

Figure 2. Two main modes of the software that accompanies the toolkit and allows to program the soft object and to play games via the manipulation of this object.

Notable exceptions do exist, e.g. diyability.org, founded by Schimmer and Cohen [33], aims to encourage more people to think creatively about technology and disabilities. They as well as Hurst et al. [11,12] suggest that DIY and personal digital fabrication techniques can and should be adopted by therapists. In sum, although there are clearly efforts to empower OTs to create their own DIY-solutions, it is not always clear to what extent these devices allow for tangible (as in computationally enhanced) interaction. Embedding sensors and electronic circuitry might discourage OTs from creating true TI solutions.

The DIY-AT toolkit evaluated in this paper can be positioned at the intersection of tangible interaction, assistive technology and the DIY approach. Its aim is to enable OTs to create their own assistive technologies involving the manipulation (pinching, bending, pushing, squeezing etc.) of soft materials.

Research questions

Currently, little work has explored how to design such a system at the cross-section of tangible interaction, occupational therapy and DIY practices. Our goal is to evaluate this DIY-AT toolkit and to find answers to the following questions:

1. Are OTs able to create solutions without the help of a technical expert?
2. Are the solutions that can be built with the DIY-AT toolkit useful for the daily practice of OTs?
3. What kind of solutions do OTs create and for what purposes?
4. What suggestions do OTs have for the improvement or extension of the toolkit?
5. Finally, from our evaluation, what recommendations arise for building DIY-AT toolkits in general?

METHODS AND MATERIALS

Materials

We started with the materials available in the traditional Skweezee System (see Figure 1). The hardware consists of an Arduino Uno board extended with a custom-made multiplexer shield. However, we decided to encapsulate these in a white box, in order not to expose them as 'electronics' to the therapists. In addition, users were provided a stripped UTP cable containing eight wires that serve as sensing electrodes, and conductive wool. We did not provide a soft object, participants should find or make their own, connect electrodes to it and fill it with conductive wool [6] to create a smart soft object.

In addition to the hardware, a new standalone software program was created. The challenge was to create a user-friendly tool that offers all needed functionality but hides all the technical complexity. Therefore, the requirements and functionality for this software were defined during two separate participatory design sessions with two OTs. This software allows OTs to test their creation, define and record different gestures, and link each gesture to a keyboard or mouse command. In this manner, other applications can be controlled by manipulating the smart object. A game, for example, normally controlled with the arrow keys, can now be played with the soft object. All settings can be saved in a file for later use.

The main screen of the software is shown in Figure 2 ("PROGRAMMING MODE"). In this example, two gestures are recorded: 'Untouched' and 'right'. Each gesture can be given a name (e.g. 'right'), linked to a color (pink in the example), a symbol (arrow pointing to the right), a sound (blip), a keyboard command (right arrow key), and can also be deleted again. The OTs can immediately test their smart object and the settings. The length of the bar on the top of the screen reflects the amplitude of the deformation, which is another element of immediate feedback. The bar becomes longer, the harder you press on the smart object. From the software, a game or application can be launched and played ("PLAY MODE"). Several games are included in the software, but OTs can also link to external games or applications.

Finally, a website was created *projects.groept.be/~skweezee/* containing details about the fabrication tutorials, software user guide several examples that could inspire therapists. These details are considered outside the scope of this paper.

Summing up, the DIY-AT toolkit consists of 1) the hardware materials and components needed to fabricate smart objects, 2) the software to program gestures and control apps, and 3) a website containing tutorials and examples.

Method

Participants were found by sending out a call to healthcare institutions and schools, specifically targeting occupational therapists. Overall 16 persons replied but due to conflicting time schedules, only 8 persons were able to take part in this stage. For a detailed overview of participants and background, see Table 1. We held both individual participatory design sessions (one participant and one researcher), as well as workshops in groups. Prior to the individual sessions and work-shops, participants were asked to have a specific client/ activity context in mind. All sessions consisted of a brief introduction to the DIY-AT toolkit, followed by a brainstorm discussion to generate and discuss ideas. Participants took the toolkit home and continued with it in their own environment. Participants were instructed to document their creations by means of notes and pictures. After a couple of weeks participants were invited back for an evaluation of the toolkit by means of a semi-structured interview.

	Sex	Age	Background
P1	M	45	Senior OT therapist, combining pediatric practice experiences and teaching
P2	F	23	OT student (intern in care facility)
P3	M	24	OT graduate (just completed internship)
P4	F	24	OT student (intern in special needs school, collaborated with P5)
P5	M	22	OT student (intern in special needs school, collaborated with P4)
P6	F	27	OT with private practice
P7	F	21	OT student, doing internship with P6
P8	F	43	ICT coordinator in OT facility, supporting OTs to find the right equipment.

Table 1. Overview of participants

During the interview we discussed their creations, and polled for their opinions on the DIY-toolkit. Questions were related to their experience of creating smart objects and using the software, how they envision the use of their solutions in their daily practice with clients, and we also asked for suggestions for improvements.

A wealth of qualitative data was gathered throughout the sessions, workshops and interviews. These interviews were transcribed at verbatim, and the data were organized and analyzed using *NVivo 10*© in order to categorize the most important results into themes. One researcher did a first exploration and coded all transcripts, notes and images.

Initially 10 themes emerged that focused on benefits, limitations and future improvements. The coding and themes were then discussed with two other researchers. A second round of axial coding was conducted, and 5 themes remained. These themes are presented below.

RESULTS

Theme 1: A diversity of solutions to tailor a diversity of clients

The OTs came up with numerous ideas and potential uses for therapeutic devices. Being soft and deformable, their creations allow for a variety of gestures such as squeezing, grasping, pinching, punching and stretching. This variety of gestures is reflected in the diversity of objects created by the participants (see Figure 3, A-L). OTs built smart objects to conduct physical exercises such as strength exercises for fine or gross motor disabilities (J,L), flexibility exercises for movement (A,G) and balance and coordination exercises (A,K). We observed that OTs used gestures ranging from full-body interaction (A,E) to bi-manual interaction (H,I) and even fine fingertip pinching (G).

Some participants created smart objects consisting of two parts, one for each hand (C,J,K,L). We were also surprised that some therapists built more than one Skweezee. P8 created smart socks (J,K,L), a pillow (E), gloves (F) and a bear (not included in Figure 1). P6 created an interactive duck (I) and an interactive floor mat(A). P1 created the spook (G,H) and the soft balls (C). The diversity of solutions and the need for variation in occupational therapy were also mentioned by some participants:

P1: *"There are many kinds of smart objects people can use in therapy: on your head, on your feet, in your clothes, as a toy. It's the variation that you need to bring to your therapy."*

P3: *"The children can choose what kind of Skweezee to use, so they will be more motivated to use it".*

P6: *"First I wanted to make a star, but then I went to look in some stores and I found the duck. The other Skweezee I came up during the presentation of the toolkit. I thought "why only train fine motor skills if you could train other motor skills as well as balance, jumping." So I came up with a big cross to lay on the floor where the children could jump on."*

Most OTs designed for and tested with young clients, and stressed that the toolkit was suited for this age group. But they added that it could also useful be for adults, especially for muscle strengthening and balance exercises.

P1: *"I will use it as a reward for children with motor problems or disabilities. For adults you can use it for strength. Also if they have high risk of falling, it would be good to use it."*

P5: *"It is appealing for children. Also the visual feedback is a motivation for kids, you can use it for training. […] I also did an internship in the MS (Multiple Sclerosis) hospital and we worked with hand functions, so they did exercises like two times opening your hand, two times closing your hand, and I think that if you use the system there, it would also motivate people. Yeah, I think it would be useful in that situation."*

Figure 3. An overview of the different creations made by occupational therapists, with the toolkit: A - an interactive floor mat, B - a cross-controller, C -, D - polar bear, E –pillow for posture control, F- interactive gloves, G – a ghost for fine motor training, I – duck for squeeze gestures, J,K,L – socks that were turned into interactive armrests, or used for squeezing thighs.

In addition, based on the profile of their clients, the therapists introduced variety and personalization by customizing the *software* offered with the toolkit. OTs pointed out that one smart object can be used for different clients, simply by 1) changing the number or type of gestures, by 2) adding different audio-visual feedback and by 3) choosing different games to be played.

P3: "I would not make a smart object for each child, but I would change the games."

P4: "For my clients I added two gestures to the smart object but I will add two more when they improve."

P6: "I used the interactive floor mat for two different clients. So I changed the game, one difficult and one easy game. I also change the feedback. For the older boy (12 years old), I added only color feedback so it is more difficult and he will improve his concentration skills. For the younger boy (8 years old), I also used text/words that describes the move."

P8 created interactive armrests; by attaching socks to a wheelchair's armrests (J) the client could interact by applying pressure with his forearm (in different positions) while being in the wheelchair. However, the same socks were also used for strength exercises in the thigh area (L) as well as for bi-manual interaction with the computer (K).

These observations suggest that the flexibility of the DIY-AT toolkit meets the needs of OTs to bring variation in the therapy, and to tailor the therapy to the diverse and complex needs of people with disabilities.

P1: "It's a non-traditional input device and it's a new way of playing game, it allows you to be very creative in whatever way that you are going to use it, whatever kind of smart object you will create, either for gross motor or fine motor gestures, or a combination."

Theme 2: Exploiting affordances of everyday objects

The smart objects built by the therapists elicited gestures that are supported by the natural tactile feedback afforded by the soft materials. Participants reported that they did select the shape and size of their object based on gestures for specific exercises. Therapists carefully thought about the physical form and manipulability, in order to convey how to handle an object. For example, P1 who wanted to treat a client with fine motor skills disabilities, and created a ghost (G,H) with small balls at the end.

P1: "I see a lot of children in my head using my spooky (ghost) for fine motor exercises, for example the pinch grip. So I installed a small ball at each corner. The gestures are 'taking a ball with the pinch grip'."

The creativity that the DIY-AT toolkit offers to the therapists is that they can select or create any shape, color, size, texture and appearance of their physical creation. All the participants except one, created their smart objects repurposing everyday objects (plush toys, socks, pillows, etc). Most of our participants used materials that they found in their home or at work. They were also pleased that only relatively cheap materials were needed. Only the "controller" shown in figure (B) was made from scratch.

Many of the OTs created a smart object that was formed either by an old plush toy or looked like a plush toy children already owned. This increased the familiarity of the clients with the tool and so their motivation. Therapists often relied on metaphors to trigger existing mental models from other devices and to elicit the desired gesture. Both P3 and P6 created a kind of cross-controller:

P3: "If they (young clients) have an old bear that they do not use anymore, they could make a game controller with that. So they will be not afraid of their own object."

P4: "We choose the polar bear because it resembles many cuddly toys. They are not afraid of it."

Whereas the authors of this paper only thought of standalone objects, some OTs took advantage of the physical environment of the and used the toolkit to augment it. For example, P6 created an interactive floor mat (A) that was used for balance exercises, jumping from one part of the floor to the other.

Theme 3: Iterative design and tinkering

Assistive solutions have to be fitted to the clients' profile and their complex needs, therefore this calls for an iterative design and evaluation process. In our observations we found evidence of this iterative process where OTs first conducted some initial tests with the client and then re-adjusted their prototypes to ensure a successful therapy session.

P2: "I was not sure how much wool to add. My client has serious gross motor disabilities. I needed to test it with him, otherwise my gesture with the balls could be very hard for him to squeeze."

Being able to solve small problems without help and being able to tinker is important within a creative process. We found that participants felt confident to tinker with the toolkit and fix small problems that they encountered. Participants also experienced the limitations of the system. For example, because of the limited number of electrodes (eight), the 'sensitivity' of a smart object to certain gestures can be an issue.

P3: *"Also, I had a problem with the recognition [...] I opened my smart object and I clipped some of the length of the wires, and then it was fine. I think I was using too much wool. I solved it myself."*

P8: "I first designed the glove for wearable gestures but that didn't really work. So then I found out that I can program pinch gestures for fine motor disabilities. So I changed it."

However, our participants demonstrated self-efficacy, they were confident in their own ability to create and program their smart objects, to tinker and tailor their creations to the clients.

P6: "You don't need to think 'how should I do it'. You can learn the procedure very fast, and easily and remember it for the next time."

Theme 4: Meaningful feedback for playful motivation

As mentioned before, the software allows to control applications or play games using the smart objects as controller. Certainly children see this as a reward; interacting with a computer has a lot of added value for them.

P6: "It's not as boring as some of the common treatments of fine motor skills, and they get to work with a computer, so it makes it less 'therapeutic'."

An additional motivation was given to the clients due to the uniqueness and playfulness of common objects that serve as a game controller.

P1: "It's a new way of playing game and it's a non-traditional input device."

P4: "When I was explaining how the soft controller is working, they were grabbing it and trying to use it".

The system turned out not to be suitable for fast-paced games. The response time of the system is too long for such games. However, this was not a big concern for the majority of our participants, because they preferred games that did not require quick reactions, also as seen in [30]. Moreover, for some clients fast-paced games would not be appropriate for therapy.

P5: "The system didn't always respond on time, so if you squeeze the objects it takes some time to respond. So, it is not like you do it on a keyboard that reacts immediately"

P8: "When they know there is time pressure, their muscles are freeze. In the school that I work, most of the children have problems with controlling their muscles."

OTs like to include cognitive challenges in the exercises for their clients, so educational or puzzle games can also be very suitable. There should be a variety in the complexity offered by the games, starting from very simple and easy games for most cognitively impaired children.

P8: "Games should take into consideration mental disabilities. The difficulty of a game is also related to the number of gestures needed. Tetris (five gestures) requires a lot of motor coordination and cognitive load."

All participants strongly requested to have a set of embedded therapy games. These games should have a limited number of game commands that would translate into a low number of gestures in their smart object.

Theme 5: Platforms to learn and share, and build upon

One of the key factors in DIY culture is a community [20] to create a sense of identity, but also to enable learning, sharing and building on other's works [13]. While obviously we could not offer OTs an established community, we implemented a website that contained tutorials and examples of solutions (made by us) in order to facilitate the creations with the toolkit. OTs expressed a need for these tutorials and problem solving on demand. From the OTs' comments – *"Great tutorials but too much!"*– we realized however that the provided tutorials should be briefer, containing only the basic tip that would apply to a given case without going into too technical details. Problem solving support should be given to the therapist on demand. Participants emphasized this need: *"Could I ask feedback from the community when I had a question?"*

Moreover, a DIY project does not have to be a significant undertaking every time. Sometimes, it is enough to add something small or tweak existing components [5]. OTs suggest to provide good defaults or examples to start from.

P5: "It would be interesting to have some standard models, in case you do not have a lot of time."

This observation lead us to believe that in order to accommodate the therapists, the website that accompanies the toolkit should be extended, and include briefer tutorials, tailored to address specific issues. In addition, we should provide a small number of ready-to-use templates that can be ordered from the site.

DISCUSSION

While the DIY community is characterized by amateurs looking for ways of self-expression, the OT community consists of professionals who are motivated to find solutions for their clients. Hence the meaning of DIY for OTs is not driven by a culture of "rebelliousness or anti-consumerism" [13]. Rather, OTs are driven by empowering clients with complex needs in their daily life activities. OTs constantly adapt and repurpose object to help clients. Hence, OTs do embrace DIY, yet computational augmentation of physical objects is still a hurdle for many [1]. As one of our participants explained:

P6: "We are creative as OTs and we learn to make tools that will help the clients. But we cannot connect them with the computer."

Revisiting the aforementioned research questions mentioned above, we can conclude that OTs were able to build solutions without the aid of technical experts. We observed a variety of creations, illustrating on one the hand the need of OTs to find solutions for very different types of exercises, and on the other hand the flexibility of our DIY-AT toolkit. Certainly clients that are more difficult to motivate welcome the playful interactions. Finally, OTs suggested the availability of brief tutorials and ready-to-use templates.

CONCLUSION

It was our aim to bring DIY to occupational therapists with our toolkit, but equally to aspire other researchers. Reflecting back on the five themes that emerged from our evaluation, we believe these can also be considered as guidelines for designing any successful DIY-toolkit within the field of '*assistive therapies'*.

Firstly, a DIY-AT toolkit should ensure that it can *deliver a diversity of solutions to tailor a diversity of clients*. No person with special needs is alike, and even with one client there is a constant need for adaptations during rehabilitation or due to degenerative processes. If a therapist is going to invest time and energy in building an assistive solution, it should be easy to reuse, adapt and extend this. Hence our evaluation confirms the need for flexibility to adapt the technology to changes in ability, needs and lifestyles [17].

Secondly, occupational therapists are creative in making tools. They see affordances for therapy in the diversity of everyday objects. Therefore, DIY-AT toolkits should support this creativity and *allow for hacking and repurposing these everyday objects*. Obviously, this reduces the cost, and can reduce barriers to procuring such a device.

As aforementioned, OTs do embrace DIY, yet computational augmentation of physical objects is a hurdle for many. Therefore, any toolkit should aim to *provide therapists with the confidence that building these solutions is easy*. We took great care in designing user-friendly software and avoiding 'engineering language'. Also we didn't expose the hardware as 'electronics' but we encapsulated it in a box. We believe these decisions in part gave the therapists self-confidence and stimulated them in tinkering. Tinkering also supports an iterative process which in turn is necessary to support the first guideline mentioned; solutions should be easy to adapt and extend.

Fourthly, toolkits should include means to *offer meaningful feedback*. The initial Skweezee system was simply an input device that didn't provide any motivation for interaction (other than its form). Assistive tools in therapy need a 'purpose'. Being able to give clients a challenge and meaningful rewards is essential to any therapy.

Finally, not surprisingly, *provide an online support platform*. We felt that therapists welcomed an online community not so much to be part of an ideology or for self-expression, but rather for more practical reasons. Therefore, rather than a community, one should provide a platform that provides answers to technical issues, as well as examples and templates that promote the OTs creativity.

We hope that the above guidelines can inform the designers of future DIY-AT toolkit to empower therapists and ensure that 'in vivo' generative design takes place, hence to *make the making more accessible*.

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